CLAIMS:

1. A method of forming a seal in a fuel cell assembly comprising a plurality of separate elements, the method comprising:

(a) assembling the separate elements of the fuel cell together;

(b) providing a groove network extending through the separate elements and a filling port open to the exterior in communication with the groove network;

(c) connecting a source of uncured liquid seal material to the filling port and injecting the seal material into the groove network to fill the groove network and simultaneously venting gas from the groove network; and

(d) curing the seal material, to form a seal in the groove network.

2. A method as claimed in claim 1, which includes filling the groove network for a predetermined time at a predetermined pressure, to ensure filling of the groove network.

3. A method as claimed in claim 2, which includes providing said separate elements with groove segments, for forming the groove network, and cleaning the groove segments prior to assembling the separate elements, to promote bonding of the seal material to the separate elements.

4. A method as claimed in claim 3, which includes providing surfaces of the separate elements with a primer, to promote bonding of the seal material thereto.

5. A method as claimed in claim 4, which includes priming the separate elements by one of:

applying a primer in liquid form to the separate elements;

plating a primer onto the separate elements; and

incorporating a primer material within the material of selected separate elements so as to improve the bonding capability of the surface of each such separate element to the seal material.

6. A method as claimed in claim 2, which includes providing a liquid silicone elastomeric material as the seal material and curing the seal material at an elevated temperature for a predetermined time.

7. A method as claimed in claim 6, which includes curing the seal material by passing heated water through the fuel cell assembly.

8. A method is claimed in claim 6, which includes preheating the assembled stack, prior to filling with groove network with seal material.

9. A method as claimed in claim 2, which includes providing the separate elements with groove segments for forming the groove network, assembling the separate elements together in abutting relationship and clamping the separate elements together, prior to injecting the seal material into the groove network.

10. A method as claimed in 9, which includes mounting the assembled elements in a mold and injecting the seal material around the exterior of the fuel cell assembly and simultaneously permitting seal material to flow into the groove network from the exterior, thereby to form said seal and to insulate said stack.

11. A method as claimed in claim 9, which includes providing a membrane electrode assembly a proton exchange membrane and gas diffusion media on both sides of the proton exchange membrane, and providing the proton exchange membrane with an external mounting flange, and causing the seal material to bond to the mounting flange, to seal the membrane exchange assembly in position.

12. A method as claimed in claim 9, which includes providing a membrane electrode assembly including a proton exchange membrane and gas diffusion media on both sides of the proton exchange membrane, and having the seal material to bond to the proton exchange membrane.

13. A method as claimed in claim 11, which includes providing a plurality of fuel cells within the fuel cell stack, providing each fuel cell with a pair of flow field plates, providing the mounting flange and the gas diffusion media extending to peripheries of the flow field plates and providing a seal for each fuel cell around the edges of the flange and the gas diffusion media and bonded to the flow field plates.

14. A method as claimed in claim 12, which includes providing a plurality of fuel cells within the fuel stack, providing each fuel cell with a pair of flow field plates, providing the proton exchange membrane and the gas diffusion media extending to peripheries of the flow field plates and providing a seal for each fuel cell around the edges of the proton exchange membrane and the gas diffusion media and bonded to the flow field plates.

15. A method as claimed in 9, which includes, for each fuel cell in the fuel cell assembly, providing an anode flow field plate and a cathode flow field plate having facing, front surfaces, providing groove segments in said facing, front faces of the anode and cathode flow field plates defining a groove extending around the periphery of the membrane exchange assembly, and providing the membrane exchange assembly with a periphery which terminates in said groove without extending all the way across the groove.

16. A method as claimed in 9, which includes aligning the separate elements and clamping the said separate elements, prior to injecting the seal material.

17. A method as claimed in claim 3, which includes providing a proton exchange membrane between the anode and cathode flow field plates and,

providing a gas diffusion layer on either side of the proton exchange, providing each of the anode and cathode flow field plates with a recess to accommodate one of the gas diffusion layers, and clamping the anode and cathode flow field plates, such that pressure on the gas diffusion layers is determined by depths of said recesses and is unaffected by injection of the seal material.

18. A method as claimed in claim 16, which includes, after curing the seal material, one of removing the clamping of the elements whereby the seal material maintains the separate elements bonded to one another, and adjusting the clamping pressure to a final clamping pressure.

19. A method as claimed in claim 16, which includes, after clamping the separate elements together, mounting the separate elements in a mold and providing connection apertures between the groove network within the fuel cell assembly and the exterior thereof, and injecting the seal material into the mold around the exterior of the fuel cell assembly, whereby the seal material covers the exterior of the fuel cell assembly and flows through said connection apertures into the internal groove network.

20. A method as claimed in claim 19, which includes providing the mold with a profile to define individual external seals at joints between adjacent elements of the fuel cell.

21. A method as claimed in claim 1, which includes forming at least one vent for venting air from the groove network by scratching a surface of at least one of said separate elements.

22. A method as claimed in claim 2, which includes providing, for each fuel cell, a proton exchange membrane, and opposed cathode and anode flow field plates on either side of the proton exchange membrane, and offset grooves in the opposed flow field plates to prevent distortion of the proton exchange membrane during delivery of the liquid seal material.

23. A method as claimed in claim 1, which includes delivering the liquid seal material at a pressure in the range 1-2000 psig, more preferably in the range of 80-300 psig.

24. A method as claimed in claim 1, which includes providing at least two separate groove networks, injecting a separate liquid seal material into each groove network of the fuel cell and selecting the composition of each liquid seal material, to provide compatibility with materials and liquids required for fuel cell operation and durability.

25. A method as claimed in claim 24, wherein component (a) is a vinyl terminated methyltrifluoropropyl polysiloxane homopolymer.

26. A method as claimed in claim 1, in which the curable elastomeric material comprises at least one of: an ethylene/acrylic polymer; a fluoro elastomer; and an Ethylene Propylene Terpolymer.

27. A method as claimed in claim 1, in which the curable elastomeric material comprises a flexible or rigid epoxy resin.

28. A method as claimed in claim 1, in which the curable elastomeric material comprises a thermoplastic elastomer.

29. A method as claimed in claim 28, in which the thermoplastic elastomer comprises a polyester elastomer.

30. A method of forming a seal in an electrochemical cell assembly comprising a plurality of separate elements, the method comprising:

(a) assembling the separate elements of the electrochemical cell assembly together;

(b) providing a groove network extending through the separate elements and a filling port open to the exterior in communication with the groove network;

(c) connecting a source of uncured liquid seal material to the filling port and injecting the seal material into the groove network to fill the groove network and simultaneously venting gas from the groove network; and

(d) curing the seal material, to form a seal in the groove network.